

IN THE CLAIMS:

This listing of the claims replaces all prior versions and listings of the claims. Please cancel claims 5, 15, 21, 25 and 29 and amend claims 13 and 17 as follows:

1 Claim 1. (previously presented) An image transform method, for
2 transforming original input image data into image data expanded by a
3 ratio represented by a rational number or an integer, comprising the
4 steps of:

5 reducing correlation in the vertical and horizontal directions of
6 an image that is linearly expanded in the vertical and horizontal
7 directions to generate first expanded image data by a rank order
8 processing in a window having a predetermined size wherein a target
9 pixel and its neighboring pixels in the linearly expanded image data
10 are included;

11 performing linear interpolation, based on correlation with a
12 target pixel constituting said original image data and neighboring
13 pixels arranged in oblique directions, using said neighboring pixels to
14 generate second expanded image data by determining an interpolation
15 direction, wherein the neighboring pixels comprise a first neighboring
16 pixel and a second neighboring pixel, and wherein determining an
17 interpolation direction comprises:

18 calculating a left oblique difference using the target
19 pixel and the first neighboring pixel;

20 calculating a right oblique difference using the target
21 pixel and the second neighboring pixel;

22 determining the left oblique direction to be the
23 interpolation direction when the left oblique difference is smaller
24 than a threshold value and when the right oblique difference is greater
25 than a threshold value; and

26 determining the right oblique direction to be the
27 interpolation direction when the left oblique difference is greater
28 than a threshold value and when the right oblique difference is smaller
29 than a threshold value; and

30 employing said first expanded image data and said second expanded
31 image data in an arithmetic combination to generate a final image.

Claims 2-5 (canceled)

1 Claim 6. (previously presented) An image transform method, for
2 transforming original input image data into image data expanded by a
3 ratio represented by a rational number or an integer, comprising the
4 steps of:

5 forming an image by linearly expanding original image data in the
6 vertical and horizontal directions; and

7 reducing the vertical and horizontal directional correlation of
8 said image through a rank order processing to generate a final expanded
9 image;

10 determining, for said expanded image, whether the contrast in
11 said original image data can be maintained at a predetermined level;
12 and

13 extracting a high frequency component from said expanded image,
14 when said contrast can not be maintained at said predetermined level,
15 and adding said frequency component multiplied by a constant to said
16 expanded image, or subtracting said frequency component multiplied by a
17 constant from said expanded image.

Claims 7-9. (canceled)

1 Claim 10. (previously presented) An image processing apparatus
2 comprising:

3 input means for entering original image data to be expanded;

4 vertical and horizontal directional interpolation means for
5 interpolating said original image data in the vertical and horizontal
6 directions;

7 vertical and horizontal directional correlation reduction means
8 for reducing correlation of the obtained image in the vertical and
9 horizontal directions;

10 oblique direction detection means for detecting an oblique
11 direction having a strong correlation with a target pixel and
12 neighboring pixels in said original image data, wherein the neighboring
13 pixels comprise a first neighboring pixel and a second neighboring
14 pixel, and wherein detecting an oblique direction comprises:

15 calculating a left oblique difference using the target
16 pixel and the first neighboring pixel;
17 calculating a right oblique difference using the target
18 pixel and the second neighboring pixel;
19 detecting the left oblique direction to be the oblique
20 direction when the left oblique difference is smaller than a threshold
21 value and when the right oblique difference is greater than a threshold
22 value; and
23 detecting the right oblique direction to be the oblique
24 direction when the left oblique difference is greater than a threshold
25 value and when the right oblique difference is smaller than a threshold
26 value; and
27 directional interpolation means for employing said neighboring
28 pixels in said detected oblique direction to perform interpolation in
29 said oblique direction.

1 Claim 11. (original) The image processing apparatus according to
2 claim 10, further comprising:

3 generation means for generating expanded image data based on an
4 image obtained by said vertical and horizontal directional correlation
5 reduction means and an image obtained by said oblique directional
6 interpolation means.

1 Claim 12. (original) The image processing apparatus according to
2 claim 11, further comprising:

3 input means for entering, as an adjustment value, the personal
4 preference of a user concerning image quality,

5 wherein said generation means employs said adjustment value to
6 synthesize said image obtained by said vertical and horizontal
7 directional correlation reduction means with said image obtained by
8 said oblique directional interpolation means.

1 Claim 13. (currently amended) The image processing apparatus
2 according to claim 10, wherein said vertical and horizontal directional
3 correlation reduction means performs ~~the~~ a ranked median value
4 selection, for the target pixel and its neighboring pixels in the

5 linearly expanded image data, and thereby reduces the correlation of an
6 image in the vertical and horizontal direction.

Claims 14-15. (canceled)

1 Claim 16. (previously presented) An image processing apparatus
2 for transforming original input image data into expanded image data
3 comprising:

4 an interpolation direction determination unit for reading a
5 target pixel and neighboring pixels in original image data, and for
6 determining an interpolation direction, wherein the neighboring pixels
7 comprise a first neighboring pixel and a second neighboring pixel, and
8 wherein determining an interpolation direction comprises:

9 calculating a left oblique difference using the target
10 pixel and the first neighboring pixel;

11 calculating a right oblique difference using the target
12 pixel and the second neighboring pixel;

13 detecting the left oblique direction to be the
14 interpolation direction when the left oblique difference is smaller
15 than a threshold value and when the right oblique difference is greater
16 than a threshold value; and

17 detecting the right oblique direction to be the
18 interpolation direction when the left oblique difference is greater
19 than a threshold value and when the right oblique difference is smaller
20 than a threshold value; and

21 an oblique directional linear interpolation unit for performing
22 linear interpolation for said target pixel by using said neighboring
23 pixels arranged in said determined interpolation direction.

1 Claim 17. (currently amended) The image processing apparatus
2 according to claim 16, wherein determining the interpolation direction
3 further comprises:

4 reading pixels in a mask around a point;

5 calculating a left cumulative value by summing pixel difference
6 values for the left oblique direction;

7 calculating a right cumulative value by summing pixel difference
8 values for the right oblique direction;

9 determining the vertical and horizontal directions to be
 10 interpolation directions when the absolute value of the left cumulative
 11 value minus the right cumulative value is smaller than a threshold
 12 value;

13 determining the left oblique direction to be the interpolation
 14 direction when the absolute value of the left cumulative value minus
 15 the right cumulative value is greater than a threshold value and when
 16 the left cumulative value is greater than the right cumulative value;
 17 and

18 determining the right oblique direction to be the interpolation
 19 direction when the absolute value of the left cumulative value minus
 20 the right cumulative value is greater than a threshold value and when
 21 the left cumulative value is smaller than the right cumulative value.

22 ~~said interpolation direction determination unit reads peripheral~~
 23 ~~pixels arranged within a predetermined mask range adjacent to said~~
 24 ~~target pixel and/or said neighbor pixels and adds together the~~
 25 ~~differences between said peripheral pixels and said target pixel and~~
 26 ~~said neighbor pixels, and determines said interpolation direction based~~
 27 ~~on the cumulative value of said differences.~~

Claims 18-19. (canceled)

1 Claim 20. (previously presented) An article of manufacture
 2 comprising a computer usable medium having computer readable program
 3 code means embodied therein for causing image transformation, the
 4 computer readable program code means in said article of manufacture
 5 comprising computer readable program code means for causing a computer
 6 to effect the steps of claim 1.

Claims 21-23. (canceled)

1 Claim 24. (original) A program storage device readable by
 2 machine, tangibly embodying a program of instructions executable by the
 3 machine to perform method steps for image transformation, said method
 4 steps comprising the steps of claim 1.

Claims 25-27. (canceled)

1 Claim 28. (previously presented) A computer program product
 2 comprising a computer usable medium having computer readable program
 3 code means embedded therein for causing image processing, the computer

4 readable program code means in said computer program product comprising
5 computer readable program code means for causing a computer to effect
6 the steps of claim 10.

Claim 29. (canceled)

1 Claim 30. (previously presented) A computer program product
2 comprising a computer usable medium having computer readable program
3 code means embedded therein for causing image processing, the computer
4 readable program code means in said computer program product comprising
5 computer readable program code means for causing a computer to effect
6 the steps of claim 16.

Claims 31-33. (canceled)